# Genetics and Plant Breeding–III

## Factors affecting radiation effects on chemical in mutation breeding

Various chemicals either protect from radiation damage or increase radio sensitivity. The protective chemicals are cyanides, nitrites, sulphur or sulfhydryl containing compounds like amines amino acids and certain chelating agents which reduce radiation effect in the following ways:

i. By reducing oxygen tension in the cells.

ii. By acting as traps for free radicles.

iii. By combining with biologically important molecules.

iv. By fostering repair mechanism that reduce primary damage.

Certain chemicals increase radiation effects in cells. For eg. Mn, Cu, Zn increase the mutagenic effectiveness. They may act via increased absorption of photons or through indirect action of oxygen.

## List the breeding methods of self pollinated crops

Breeding methods in self pollinated crops are given below;

**1. Introduction.**

**2. Selection.**

a) Mass selection.

b) Pure line selection.

**3. Hybridization.**

a) Pedigree method.

b) Bulk method.

c) Backcross method.

d) Multiple cross method.

e) Single seed descent method (SSDM).

**4. Mutation breeding.**

## Principal and practices relating to evaluation and release of new crop varieties

Variety release/registration system in Bangladesh:

1. As per the present seed rule, the varieties of five notified crops (Rice, Wheat, Jute , Potato and Sugarcane) are released by the NSB.

2. For all other crops (Non-notified) the system is registration of the varieties by the NSB.

3. In case of release , the organization involved in plant breeding propose the variety for release to the technical committee (TC) of NSB with adequate data on many different characters.

4. The proposed varieties are then tested on the field by Field Evaluation Team (FET) of the TC. FET has placed their opinion before the TC. TC then may recommend the case for the NSB approval.

5. On approval of the NSB, the name of the variety gets into the gazette notification, by the Ministry of Agriculture GOB .

6. The National Seed Board (NSB) is the highest body for variety release and registration in Bangladesh.

7. NSB requires a form to be filled with all relevant data of the variety of any non-notified crops and submitted to the technical committee (TC) of NSB or the Seed Wing for registration. There is no requirement of field evaluation of the variety to be registered.

8. This is not a good provision but the government has adopted it to encourage private sector seed industry development, but the provision is also not favourable for the private sector seed industrialist.

## Define plant breeding and Objectives of plant breeding

**Plant breeding:** The branch of biology concerned with the changing of genotype of plants so that they become more useful to man. It is an art and science of improving the (heredity) genetic pattern of crop plants in relation their social need and economic important.

### Objectives of plant breeding

i) Most of the breeding programmes aim at higher crop yield.

ii) Development of crop quality and quantity.

iii) Resistant to insects and diseases.

iv) Maturity duration changing.

v) Modification of agronomic/horticultural characteristics such as plant height, tillering, branching etc.

vi) Resistant to different adverse situation.

vii) Development of photo insensitive crop.

viii) Maintain and remove the dormancy.

ix) Develop the varieties for new seasons.

x) Development of varieties for moisture and salt tolerance.

xi) To eliminate toxic substances (removal of neurotoxin and BOAA in khesari) would increase the nutritional value of the crop.

## Cytoplasmic genetic male sterility techniques for hybrid seed production

This system is the most widely used method in hybrid seed production. The system is based on a cytoplasm that produce male sterility and on a gene that restores fertility in the presence of male sterile cytoplasm. The use of this system in hybrid seed production is outline below-

### Production of Single cross hybrid varieties

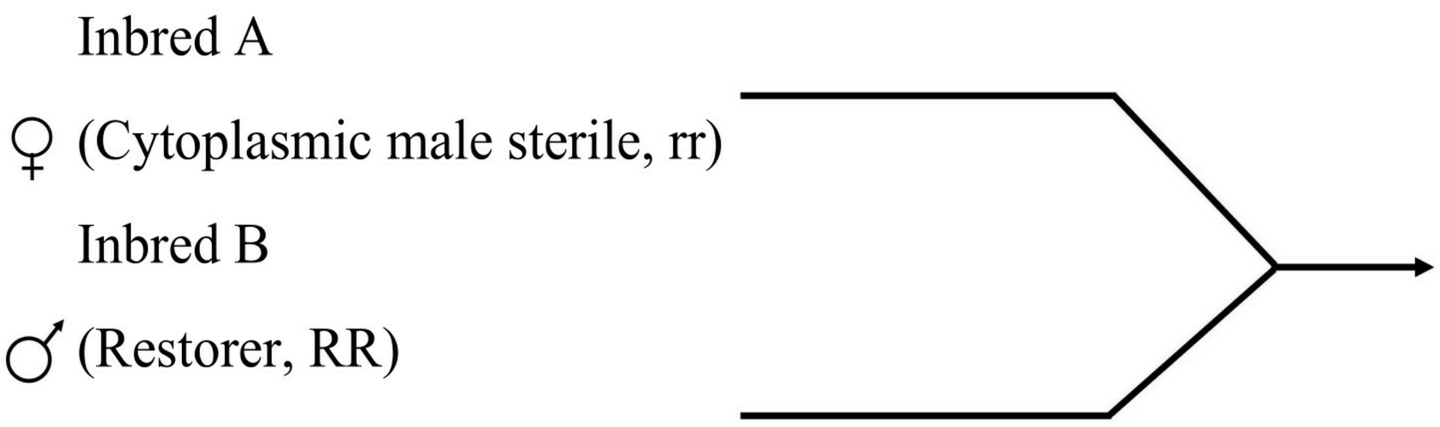
For the production of a single cross hybrid seed, a Cytoplasmic male sterile (CMS) line is used as the female parent while the male parent is a restorer. The seed set on the female parent (the male sterile line) in the hybrid seed while that produced on the male parent is selfed seed. The resulting hybrid will be make fertile since it has received the restorer gene from the male parent. Generally 2 rows of the male parent are planted after every two rows of the CMS female parent. But when the male inbred produces sufficient pollen, two rows of the male inbred may be planted after every 3-4 rows of the female parent.

### Production of double cross hybrid varieties

Seeds of double cross hybrids varieties are produced by crossing two single crosses, one male sterile and other male fertile. The male sterile single cross is produced by crossing a CMS line with a non restorer fertile (male) line. The male fertile single cross may be produced in one of the following two days. In first approach a CMS line is crossed with a restorer line (Scheme-I). In the second method two restorer line are crossed together, one of the restorer lines serves as female (Scheme-II). All the plants in the double cross in this case would be fertile.

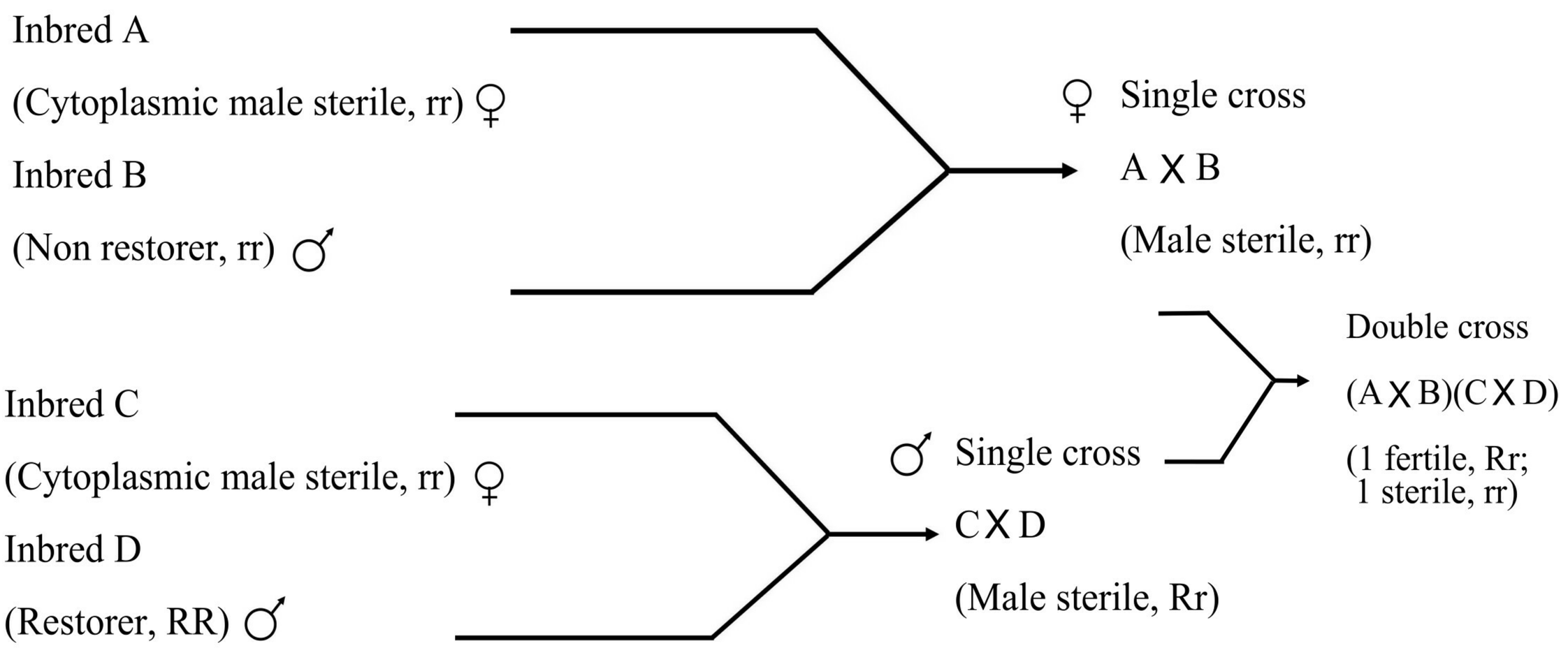
**Figure of Use of Cytoplasmic genetic male sterility for the production of Hybrid seed**

## Single Cross

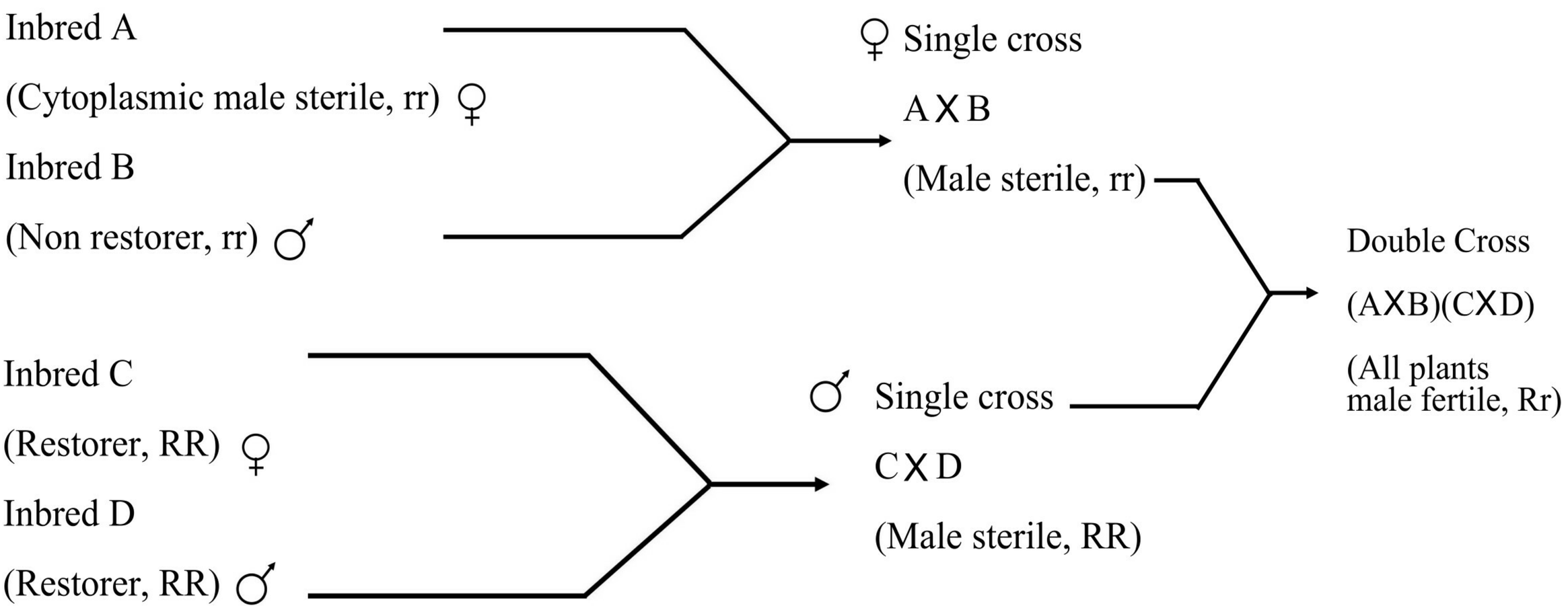



## Double Cross

### Scheme-I




### Scheme-II



**Comparative study among the four methods of recurrent selection**

| Item | SRC | RS-GCA | RS-SCA | RRS |
|---|---|---|---|---|
| 1. Source population | 1 | 1 | 1 | 2 |
| 2. Duration/Selection cycle | 2 years | 3 years | 3 years | 3 years |
| 3. Types of tester | No tester | Heterozygous | Homozygous | Open population |
| 4.Exploitation/ Utilization of genetic variance | Additive genetic variance | Additive genetic variance | Non-additive genetic variance | Both additive and non-additive genetic variance |
| 5. Type of test | No test | GCA-test | SCA- test | Both GCA and SCA test |

**Procedure of mutation breeding for oligogenic traits with flow diagram**

In order to isolate a specified mutant, seeds from all $M_1$ plants representing one mutagen dose may be harvested in bulk or handled according to single seed descent method. An alternative and more preferred procedure is described here which aims at a selection for a recessive mutant allele of an oligogene.

*M@hbub*

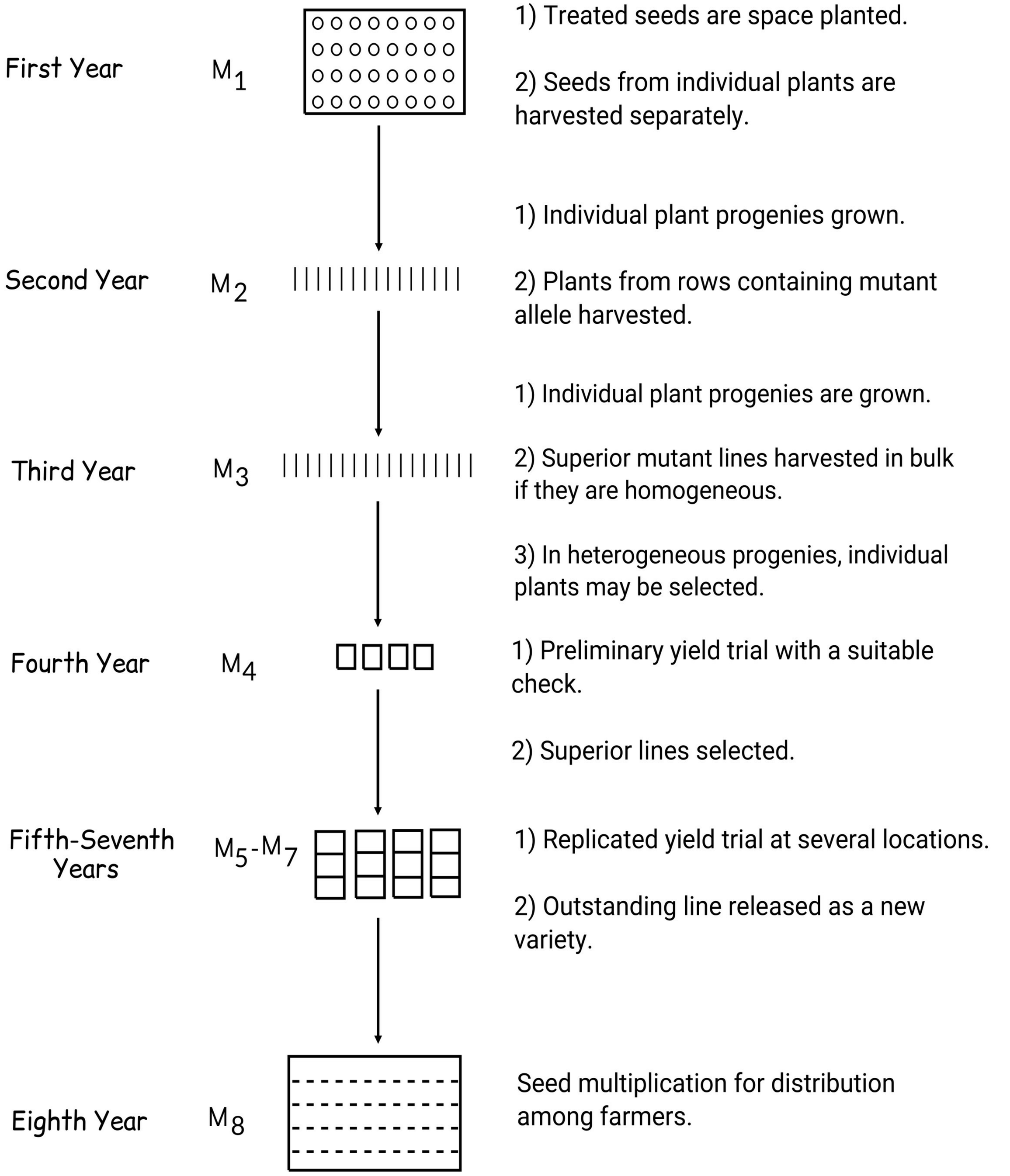



**Fig: A generalized scheme for mutation breeding for an oligogenic traits**

## Production of allien addition and Substitution lines through a flow diagram

*M@hbub*

PLOIDY — ♀ Recipient Species S (4X) Disease Susceptible — X — ♂ Donor Species R (2X) Disease Resistant

Hybridize the two species R and S

Genome — AA BB — CC

Gamets — AB — C

F1 hybrid — ABC (3X)

F1 is usually sterile. Chromosome number is doubled by colchicino.

Colchicine

♂ AA BB X AA BB CC (6X) ♀

Recipient Species S — Amphidiploid

The amphidiploid thus produced is fertile. It is backcrossed to the recipient Species S

♂ AA BB X AA BB C (5X) ♀

Species S

The progeny is a pentaploid with a single C genome from the species R and the full diploid complement of species S.

♂ AA BB X AA BB + C ♀ (4X + Few chromosomes From genome C of species R)

The progeny have full somatic complement of S and a low chromosomes from R. Disease resistance plants are selected and back crossed to species S.

AA BB + 1 C and AABB - 1 + 1 C

(4X + 1 Chromosome from C)

(4X -1+1 chromosomes from C)

Disease resistant plants similar to species S are selected. Alien addition monosome has one extra chromosome; Substitution monosome has 2n number of S.

Selfing

AA BB + CC and AA BB - 2 + CC

(4X +1 pair of chromosomes from Species R)

(4X -1 pair + 1 pair of chromosomes from species R)

2n+2 disease resistant plants are alien addition lines. Resistant plants with 2n chromosome are alien substitution line.